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# Economic and Nutritional Implications from Changes in U.S. Agricultural Promotion Efforts

**Shuay-Tsyr Ho, Bradley J. Rickard, and Jura Liaukonyte**

Promotion programs that subsidize advertising for exported agricultural products continue to be used despite much criticism that they are an inefficient use of taxpayer money. At the same time, others have advocated for an increase in funds to support domestic advertising for fruits and vegetables. We investigate the economic and nutritional effects from changes in both export and domestic promotion expenditures for horticultural and nonhorticultural commodities. Simulation results show that even modest decreases in trade promotion expenditures coupled with a corresponding increase in domestic promotion efforts have the capacity to influence domestic market conditions, caloric intake, and nutrient consumption.

*Key Words:* advertising, export promotion, horticulture, nutrient intake, policy reform, simulation model

**JEL Classifications:** Q13, Q17, Q18

Since the inception of the Targeted Export Assistance Program in 1985 and its replacement with the Market Promotion Program in 1990, the U.S. government has had a long tradition of subsidizing promotional efforts for agricultural products in export markets through research, trade shows, or advertising campaigns. Public funds are purportedly used for promotion to raise the market share of U.S. agricultural products in an increasingly competitive international marketplace. Since 2002, the Market Access Program (MAP) has served as the main program supporting promotion for high-value agricultural products (e.g., fruits, salmon, almonds, and wine) in foreign markets. Publicly funded promotion expenditures have grown from $120 million in 1997 (U.S. General Accountability Office, 1999) to $200 million in 2011 (USDA Foreign Agricultural Service, 2012b). The Foreign Market Development (FMD) program has also provided promotion funds to expand long-term export markets for bulk products (e.g., soybean, cotton, grains, meat, wheat, and rice); the FMD program has had a budget of approximately $35 million since 2006 (USDA Foreign Agricultural Service, 2012c). Table 1 outlines some recent expenditures under the MAP and the FMD program.

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**Table 1.** Export Promotion Expenditures for Horticultural and Nonhorticultural Products, Fiscal Year 2011

| Market Access Program (MAP)[a] | | | | Foreign Market Development (FMD) Program[b] | |
|---|---|---|---|---|---|
| Horticultural Products | | Nonhorticultural Products | | Nonhorticultural Products | |
| Organization | Allocation | Organization | Allocation | Organization | Allocation |
| Washington Apple Commission | $5,199,788 | U.S. Meat Export Federation | $16,261,732 | American Soybean Association | $6,648,054 |
| Florida Department of Citrus | $4,937,966 | Food Export Association of the Midwest USA | $10,919,428 | U.S. Wheat Associates | $5,033,535 |
| National Potato Promotion Board | $4,870,824 | Western United States Agricultural Trade Association | $10,859,171 | U.S. Grains Council | $4,386,866 |
| California Walnut Commission | $4,614,261 | U.S. Grains Council | $8,621,582 | U.S. Meat Export Federation | $1,612,357 |
| Pear Bureau Northwest | $3,632,830 | Food Export USA Northeast | $8,152,605 | USA Rice Federation | $1,457,865 |
| California Table Grape Commission | $3,494,622 | U.S. Wheat Associates | $6,798,051 | USA Poultry and Egg Export Council | $1,262,021 |
| California Prune Board | $3,339,658 | Southern United States Trade Association | $5,831,384 | National Renderers Association | $837,791 |
| Sunkist Growers, Inc. | $3,107,359 | Wine Institute | $5,585,230 | American Peanut Council | $628,631 |
| Others | $17,916,743 | Others | $38,178,950 | Others | $1,293,773 |
| Total | $51,114,051 | | $111,208,133 | | $23,160,893 |

Sources: USDA Foreign Agricultural Service (2012b), USDA Foreign Agricultural Service (2012c). Total Available Fiscal Year 2011 Funding for Market Access Program (MAP) and Foreign Market Development (FMD) Program.

[a] Total available funding for the MAP in Fiscal Year 2011 was $200 million; this includes approximately $32 million in expenditures for other (nonfood) agricultural and forestry products and approximately $5.6 million in reserves that are not shown here.

[b] Total available funding for the FMD Program was $34.5 million in Fiscal Year 2011; this includes approximately $8.5 million for other agricultural and forestry products and $2.8 million in reserves that are not shown here.

There has been an ongoing and relatively large literature that studies the price, quantity, and welfare effects of export promotion programs for selected agricultural commodities or food items (e.g., Henneberry, Mutondo, and Brorsen, 2009; Kaiser, Liu, and Consignado, 2003; Le, Kaiser, and Tomek, 1998; Richards, Ispelen, and Kagan, 1997; Rosson, Hamming, and Jones, 1986). Although economists have studied the health consequences of various agricultural and food policies (see Alston, Sumner, and Vosti, 2006; Beghin and Jensen, 2008; Okrent and Alston, 2012), there is little research that examines the implications of export promotion programs on energy and nutrient intake. This article aims to fill that gap by examining the linkage between agricultural subsidies applied to export promotions and the implications for domestic welfare and the associated domestic nutritional outcomes. We examine the economic and nutritional impacts from a redirection of export promotion expenditures toward domestic promotion efforts for horticultural commodities. The MAP is the focus of our analysis because it applies to high-value specialty crops, whereas the FMD program has traditionally been applied to bulk agricultural products. Our analysis extends the study by Kinnucan and Cai (2011) that examined the impacts of nonprice export promotions on domestic consumers by considering two commodity groups—horticultural and nonhorticultural commodities—and by assessing the nutritional consequences of changes in export promotion expenditures. We also extend research by Alston et al. (2009) that examines the dietary outcomes of proposed policy changes for healthy and unhealthy foods by examining changes in caloric consumption and intake of specific nutrients.

Our research is motivated by the renewed interest among policymakers concerning the future of export promotion programs. Some policymakers have proposed elimination of the MAP as part of the 2014 Farm Bill negotiations (National Association of Wheat Growers, 2012), yet others are very supportive of export promotion efforts and there continues to be widespread support across agricultural commodity groups for continued funding (Lansing, 2012; U.S. Grains Council, 2013). In addition to these discussions among policymakers and industry stakeholders, we have also seen opposition to export promotion programs by a wide variety of social interest organizations (e.g., Ferrechio, 2012; Gelber, 2012). This is a controversial policy issue and one that is expected to continue to be debated as part of domestic and international agricultural policy discussions.

Our research is also motivated by the observation that the United States uses very little public funding to promote the consumption of horticultural crops domestically (see Table 3 in Carman and Alston, 2005), yet these crops have received a relatively large share of MAP funds for advertising initiatives in foreign markets. At the same time there is much concern over dietary health and the growing obesity epidemic in the United States over the past few decades (Flegal et al., 2010; Zhang and Wang, 2004). Many other countries actively promote the health benefits of a diet rich in fruits and vegetables using large-scale advertisements. In Australia and the United Kingdom, publicly funded advertising programs for fruits and vegetables have been shown to increase domestic consumption of fresh produce (Capacci and Mazzocchi, 2011; Pollard et al., 2008). There is wide evidence that public policy initiatives have the capacity to impact fruit and vegetable consumption and nutrient intake (Cox et al., 1998; French and Stables, 2003; Glanz and Yaroch, 2004; Pomerleau et al., 2005) and can enhance knowledge and overall awareness of healthier eating (Mangunkusumo et al., 2007; Stables et al., 2002). There is some evidence that U.S. consumers might also respond to broad-based advertising efforts for fruits and vegetables (Rickard et al., 2011); however, in the United States, government support for domestic advertising of fruits and vegetables is negligible.

## Simulation Model

Our approach to understanding the economic effects of changes in promotional efforts for agricultural commodities can be illustrated graphically. In Figure 1 we show the effects of

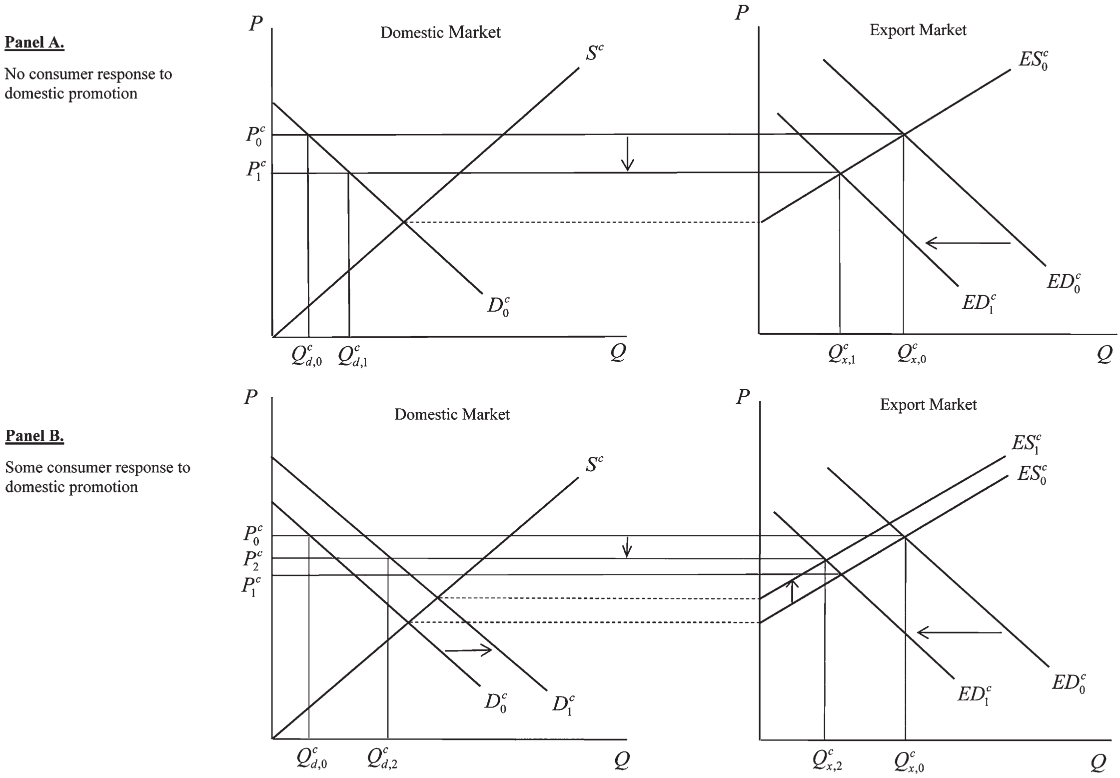


**Figure 1A–B.** Potential Effects from Changes in Export Promotion Efforts

a reduction in export promotion efforts with a redirection of funds for domestic promotion. Figure 1A outlines the likely effects of reducing government spending on agricultural trade promotions (a decrease in export demand from $ED_0^c$ to $ED_1^c$) with no consumer response to the redirected domestic advertising. Here we do not distinguish between horticultural and nonhorticultural commodities and instead focus on all commodities denoted as *c*. In this case we see a decrease in price (from $P_0^c$ to $P_1^c$), a decrease in export demand (from $Q_{x,0}^c$ to $Q_{x,1}^c$), and an increase in domestic consumption (from $Q_{d,0}^c$ to $Q_{d,1}^c$). In Figure 1B, we assume that domestic consumers do respond to domestic advertising and that there is an outward shift in domestic demand (from $D_0^c$ to $D_1^c$). Again, the price decreases, but to a lesser degree than what is observed in Figure 1A. As a result of the shift in export supply in this case (from $ES_0^c$ to $ES_1^c$), we see a larger decrease in the exported quantity in Figure 1B. The increase in domestic demand in Figure 1B also leads to a larger increase in domestic consumption.

Kinnucan and Cai (2011) examined the case of an increase in export promotion and showed how such an increase would lead to a decrease in domestic demand (through either higher domestic prices or less funds available for domestic promotion efforts); they refer to this as a cannibalization effect. Because we illustrate the case of a reduction in export promotion, the price and quantity effects in Figure 1 are similar but opposite to those outlined in Kinnucan and Cai (2011). Therefore, we describe the outcome shown in Figure 1 as one driven by a reverse cannibalization effect.

The framework introduced in Figure 1B is extended in Figure 2. Here we outline the effects of reducing export promotion for horticultural commodities in a multimarket context with consumers responding to domestic promotion efforts. In Figure 2 we separate horticultural products from nonhorticultural products and therefore use superscripts *h* and *n*

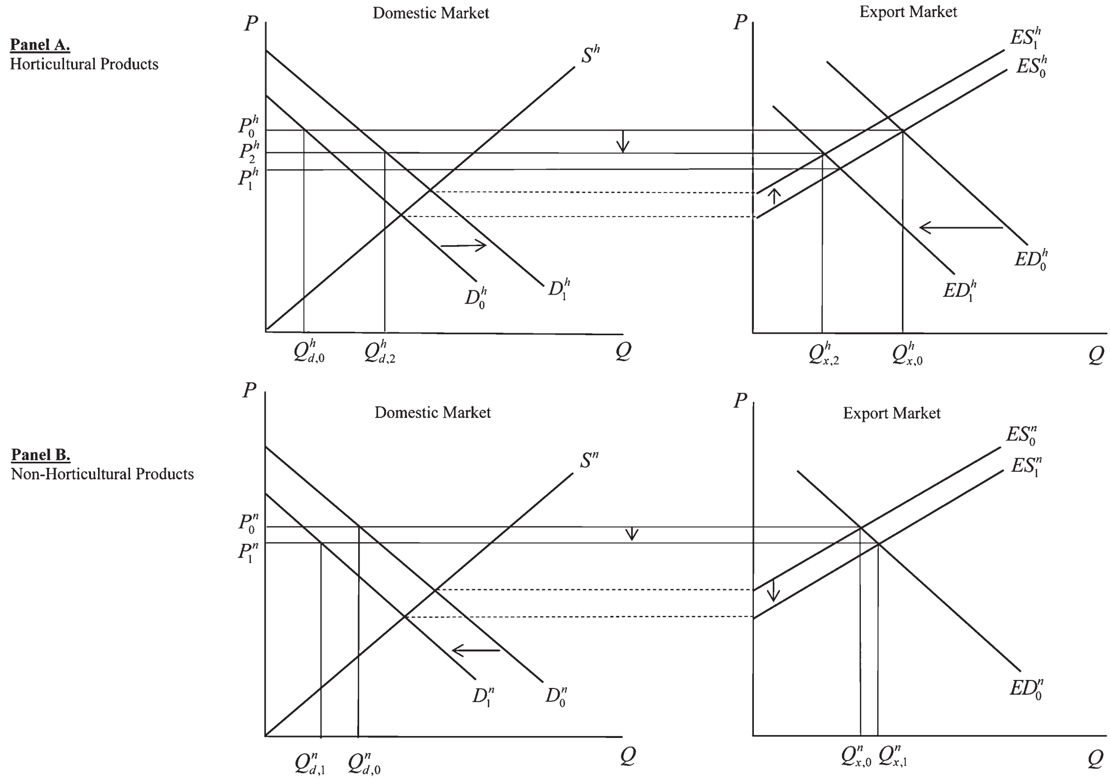


**Figure 2A–B.** Multimarket Response to Changes in Government-funded Export Promotions for Horticultural Products

to differentiate these two commodity categories. Figure 2A describes the domestic market and export market for horticultural commodities; Figure 2B describes markets for nonhorticultural commodities. The two commodity categories are modeled as substitutes in consumption in the domestic market. Here we observe that a decrease in export promotion applied to horticultural commodities leads to similar reverse cannibalization effects presented in Figure 1B; the price of horticultural commodities falls and consumption increases at home. As a result of the substitutability between the two product categories, we assume an inward shift in domestic demand for nonhorticultural commodities in Figure 1B. This, in turn, leads to an increase in the export supply of nonhorticultural commodities; the price and domestic consumption of nonhorticultural commodities are shown to fall in Figure 2.

Next we develop a multimarket partial-equilibrium model and use it to simulate the effects of reductions in export promotion subsidies following a framework outlined by Alston, Norton, and Pardey (1995), among others. The model is a system of supply, demand, and market clearing conditions for two commodity groups. Because the model is partial equilibrium in nature, aggregate income and prices of commodities outside of crop agriculture remain constant throughout the adjustment process. Solutions to the logarithmic transformation hinge on the parameters that describe supply, demand, and promotional elasticities as well as various quantity and promotional shares. The results from the simulation model are subsequently used to calculate changes in welfare, caloric consumption, and intake of selected nutrients.

(1a) $$Q_d^h = H_d\left(P^h, P^n, A_d^h, A_d^n\right)$$

(1b) $$Q_d^n = N_d\left(P^h, P^n, A_d^n, A_d^h\right)$$

(1c) $$Q_x^h = H_x\left(P^h, \tilde{A}_x^h\right)$$

(1d) $$Q_x^n = N_x\left(P^n, \tilde{A}_x^n\right)$$

(1e) $A_x^h = A_I^h - A_d^h = \tilde{A}_x^h - A_G^h$

(1f) $A_x^n = A_I^n - A_d^n = \tilde{A}_x^n - A_G^n$

(1g) $A_I^h = T^h \cdot Q_s^h$

(1h) $A_I^n = T^n \cdot Q_s^n$

(1i) $\tilde{A}_x^h = f\left(A_G^h\right)$

(1j) $\tilde{A}_x^h = f\left(A_G^h\right)$

(1k) $Q_s^h = H_s\left(P_s^h\right)$

(1l) $Q_s^n = N_s\left(P_s^n\right)$

(1m) $P_s^h = P^h - T^h$

(1n) $P_s^n = P^n - T^n$

(1o) $Q_s^h = Q_d^h + Q_x^h$

(1p) $Q_s^n = Q_d^n + Q_x^n$

Equations (1a), (1b), (1c), and (1d) describe the demand for horticultural and nonhorticultural products in domestic and export markets. Domestic demand for horticultural and nonhorticultural products ($Q_d^h$ and $Q_d^n$, respectively), where the subscript $d$ denotes the domestic market, superscript $h$ denotes horticultural products, and superscript $n$ denotes nonhorticultural products, are functions of consumer prices ($P^h$ and $P^n$) and domestic advertising expenditures ($A_d^h$ and $A_d^n$) for the two commodity categories. Export demand for horticultural and nonhorticultural products ($Q_x^h$ and $Q_x^n$, respectively), where subscript $x$ denotes the export market, are functions of the own price and the own export advertising expenditure including the subsidy ($\tilde{A}_x^h$ for horticultural products and $\tilde{A}_x^n$ for nonhorticultural products). For each commodity category, equations (1e) and (1f) show the relationships between different sources of promotion expenditures. All variables related to advertising are denoted with $A$; these include expenditures for export market promotion exclusive of the subsidy, denoted as $A_x$, industry expenditures for promotion generated by a marketing fee, denoted as $A_I$ where subscript $I$ is used to represent industry, expenditures on domestic promotion, denoted as $A_d$, total expenditures for the export market promotion inclusive of the subsidy, denoted as $\tilde{A}_x$, and the subsidy applied to export promotion, denoted as $A_G$ where subscript $G$ is used to represent government. Equations (1g) and (1h) outline the mechanism for how industry funds are raised from marketing fees, where $T^h$ and $T^n$ describe the ad valorem rate for the marketing fee for the two commodity categories. The relationship between government subsidies for export promotion and the total expenditures for export promotion are captured in equations (1i) and (1j). Equations (1k) and (1l) describe the supply of horticultural and nonhorticultural products; here $P_s^h$ and $P_s^n$ are the producer prices for horticultural and nonhorticultural products, respectively. Price-linkage equations for the horticultural and nonhorticultural products are presented in equations (1m) and (1n); market-clearing conditions for domestic and exported quantities of horticultural and nonhorticultural products are presented in equations (1o) and (1p).

A logarithmic transformation is applied to equations (1a) through (1p) to develop the following model that will be used to simulate the economic effects from specific changes in promotional efforts funded by the government. In equations (2a) to (2p), we use $d \ln Z$ to indicate a relative change in variable $Z$. The model is used to consider the impacts of changes in government-funded export promotion, where $A_G^h$ is used to describe such a change in export promotion for horticultural products and $A_G^n$ is used to describe a change in export promotion for nonhorticultural products.

(2a) $$d \ln Q_d^h = \eta_d^{hh} d \ln P^h + \eta_d^{hn} d \ln P^n + \alpha_d^{hh} d \ln A_d^h + \alpha_d^{hn} d \ln A_d^n$$

(2b) $$d \ln Q_d^n = \eta_d^{nn} d \ln P^n + \eta_d^{nh} d \ln P^h + \alpha_d^{nn} d \ln A_d^n + \alpha_d^{nh} d \ln A_d^h$$

(2c) $$d \ln Q_x^h = \eta_x^h d \ln P^h + \beta_A^h d \ln \tilde{A}_x^h$$

(2d) $$d \ln Q_x^n = \eta_x^n d \ln P^n + \beta_A^n d \ln \tilde{A}_x^n$$

(2e) $$\theta_I^h d \ln A_I^h - \theta_d^h d \ln A_d^h = \theta_x^h d \ln \tilde{A}_x^h - \theta_G^h d \ln A_G^h$$

(2f) $$\theta_I^n d \ln A_I^n - \theta_d^n d \ln A_d^n = \theta_x^n d \ln \tilde{A}_x^n - \theta_G^n d \ln A_G^n$$

(2g) $$d \ln A_I^h = d \ln T^h + d \ln Q_s^h$$

(2h) $$d \ln A_I^n = d \ln T^n + d \ln Q_s^n$$

(2i) $d\ln\tilde{A}_x^h = \varphi_x^h d\ln A_G^h$

(2j) $d\ln\tilde{A}_x^n = \varphi_x^n d\ln A_G^n$

(2k) $d\ln Q_s^h = \varepsilon^h d\ln P_s^h$

(2l) $d\ln Q_s^n = \varepsilon^n d\ln P_s^n$

(2m) $d\ln P^h = \left(1-\tau^h\right) d\ln P_s^h + \tau^h d\ln T^h$

(2n) $d\ln P^n = (1-\tau^n) d\ln P_s^n + \tau^n d\ln T^n$

(2o) $d\ln Q_s^h = k_d^h d\ln Q_d^h + k_x^h d\ln Q_x^h$

(2p) $d\ln Q_s^n = k_d^n d\ln Q_d^n + k_x^n d\ln Q_x^n$

A program was used to solve the model by making a series of substitutions across equations (2a) through (2p) such that the endogenous variables (the proportional changes in quantities and prices) are expressed as functions of the exogenous variables (the various elasticity and share parameters and the shocks related to changes in promotion efforts). The linear transformation framework is convenient as an approximation but none of the results hinge on this simplification. These equations do not involve any explicit or implicit assumptions about the functional forms used, and it is not necessarily assumed that the elasticities are constant. However, it is assumed that the supply-and-demand functions are approximately linear at the initial point of market equilibrium (Alston, Norton, and Pardey, 1995).

Values for elasticity and share parameters are held constant as exogenous changes in promotional efforts are applied. Elasticity parameters include: promotion elasticities in the domestic market denoted as $\alpha$, promotion elasticities in the export market denoted as $\beta$, supply elasticities denoted as $\varepsilon$, and the own and cross-price demand elasticities, denoted as $\eta$. The elasticity indicating the sensitivity of total spending on horticultural (nonhorticultural) export promotion to subsidies from government is denoted as $\varphi_x^h$ $\left(\varphi_x^n\right)$; we follow Kinnucan and Cai (2011) and refer to this as the budget-diversion elasticity. Consumption shares of domestic production in domestic and export markets are denoted with $k$, and the marketing fee expressed as a fraction of the demand price is denoted as $\tau$. Share identities, denoted as $\theta$, represent the promotional shares for horticultural and nonhorticultural products derived from different sources.

## Parameterization of the Model

Our simulation model requires a number of parameters; these are either estimated here, taken from the literature, or based on information from industry and government sources. The baseline values for model parameters and the relevant data sources are listed in Table 2 for horticultural products and in Table 3 for nonhorticultural products. In these tables we use the term "estimated" when a parameter is derived from the econometric results, and we use the term "calculated" when a parameter is derived from a secondary data source. When we borrow a parameter directly from another source, we list that source in the final column of the table. Next we provide more details for each of the parameters.

We borrow parameters describing domestic and export promotional expenditures from Kinnucan and Cai (2011). Initial equilibrium values for price, quantity, and promotion expenditures are set equal to their average value during the period between 2000 and 2004. Budget share parameters for both product categories are derived from available data describing U.S. government expenditures for export promotion, total U.S. expenditures for export promotion, and industry investments in promotion (following Kinnucan and Cai, 2011). Quantity shares are derived from data detailing average gross values of U.S. farm production for horticultural and nonhorticultural commodities and average export values for these two commodity categories. Marketing fees for both commodity categories, expressed as a fraction of demand price, are set to 0.004 following Kinnucan and Cai (2011) to calculate the respective industry expenditures for promotions.

We estimate budget-diversion elasticities as well as export price and export promotional elasticities for both horticultural and nonhorticultural products using annual data between 1975 and 2004. The budget-diversion elasticities are estimated following the specification used in Kinnucan and Cai (2011); for either commodity category, the elasticity is the estimated coefficient

**Table 2.** Baseline Parameters for the Horticultural Commodity Category (average values for 2000 to 2004)

| Parameter | Definition | Value | Reference |
|---|---|---|---|
| $A_G^h$ | Government expenditures for export promotion of horticultural products (million \$) | 26 | USDA Foreign Agricultural Service (2012a) |
| $\tilde{A}_x^h$ | Total expenditures for export promotion of horticultural products (million \$) | 76 | USDA-FAS |
| $A_I^h$ | Total industry spending on promotion of horticultural products (million \$) | 99 | Kinnucan and Cai (2011) |
| $A_d^h$ | Domestic promotional expenditures for horticultural products (million \$) | 49 | Kinnucan and Cai (2011) |
| $A^h$ | Total promotional expenditures for horticultural exports (million \$) | 125 | $A_I^h + A_d^h$ |
| $\theta_G^h$ | Government share of total horticultural promotion expenditures | 0.21 | $A_G^h/A^h$ |
| $\theta_I^h$ | Industry share of total horticultural promotion expenditures | 0.79 | $A_I^h/A^h$ |
| $\theta_d^h$ | Share of total horticultural promotion expenditures spent in the domestic market | 0.39 | $A_d^h/A^h$ |
| $\theta_x^h$ | Share of total horticultural promotion expenditures spent in the export market | 0.61 | $\tilde{A}_x^h/A^h$ |
| $P^hQ_S^h$ | Gross farm value of U.S. production for horticultural products (million \$) | 24,636 | USDA-ERS (2012) |
| $P_S^hQ_S^h$ | Net farm value of U.S. production for horticultural products (million \$) | 24,537 | Calculated |
| $P^hQ_x^h$ | Value of U.S. farm exports in horticultural products (million \$) | 12,082 | USDA Foreign Agricultural Service (2012a) |
| $P^hQ_d^h$ | Value of domestic consumption in horticultural products (million \$) | 12,554 | Calculated |
| $\tau^h$ | Industry marketing fees for horticultural products | 0.004 | Kinnucan and Cai (2011) |

**Table 2.** Continued

| Parameter | Definition | Value | Reference |
|---|---|---|---|
| $k_d^h$ | Quantity share of horticultural supply consumed in the domestic market | 0.51 | $P^hQ_d^h/.P^hQ_s^h$ |
| $k_x^h$ | Quantity share of horticultural supply consumed in the export market | 0.49 | $1 - k_d^h$ |
| $\varepsilon^h$ | Domestic supply elasticity for horticultural products | 0.6 | Assumed |
| $\eta_d^{hh}$ | Domestic own-price demand elasticity for horticultural products | –0.72 | Huang and Lin (2000) |
| $\eta_x^h$ | Export demand elasticity for horticultural products | –3.97 | Estimated (see Table 4) |
| $\eta_d^{hn} = \eta_d^{nh}$ | Domestic cross-price demand elasticity between horticultural and nonhorticultural products | (0.10, 0.25) | Assumed |
| $\beta_A^h$ | Export promotion elasticity for horticultural products | 0.293 | Estimated (see Table 4) |
| $\alpha_d^{hh}$ | Domestic own-promotion elasticity for horticultural products | (0, 0.01, 0.05, 0.1) | Assumed |
| $\alpha_d^{hn}$ | Domestic cross-promotion elasticity for horticultural products | (0, –0.096, –0.479, –0.958) | Calculated (see equation [4]) |
| $\varphi_x^h$ | Budget diversion elasticity for horticultural products | 0.887 | Estimated |

from regressing the logarithm of total export promotion expenditures on the logarithm of government expenditures on export promotion. Long-run export promotional elasticities for both commodity categories are estimated following the econometric framework used by Kinnucan and Cai (2011).[1] Equation (3a) outlines the model used to estimate the U.S. export value share for horticultural commodities and equation (3b) outlines the model used to estimate the U.S. export value share for nonhorticultural commodities. Following Kinnucan and Cai (2011), we use the fully modified ordinary least squares specification in our estimation work to account for unit roots, serial correlation, and endogenous right-hand-sided variables.

$$\begin{aligned}(3a)\quad & \ln\left(X_t^h/X_t^{Wgdp}\right) \\ & = \beta_0^h + \beta_P^h \ln\left(P_t^h/DEFL_t\right) + \beta_{PS}^h \ln\left(P_t^{C,h}\right) \\ & \quad + \beta_{XR}\ln(XR_t) + \beta_Y \ln\left(X_t^{Wgdp}/DEFL_t\right) \\ & \quad + \beta_A^h \ln\left(GW_t^h\right) + \beta_{LAG}^h \ln\left(X_{t-1}^h/X_{t-1}^{Wgdp}\right) + \mu_t^h\end{aligned}$$

$$\begin{aligned}(3b)\quad & \ln\left(X_t^n/X_t^{Wgdp}\right) \\ & = \beta_0^n + \beta_P^n \ln\left(P_t^n/DEFL_t\right) + \beta_{PS}^n \ln\left(P_t^{C,n}\right) \\ & \quad + \beta_{XR}\ln(XR_t) + \beta_Y \ln\left(X_t^{Wgdp}/DEFL_t\right) \\ & \quad + \beta_A^n \ln\left(GW_t^n\right) + \beta_{LAG}^n \ln\left(X_{t-1}^n/X_{t-1}^{Wgdp}\right) + \mu_t^n\end{aligned}$$

In these specifications, $X_t$ represents the nominal value of U.S. agricultural exports in year $t$

[1] The data for the period between 1975 and 2004 were made available to us from Kinnucan and Cai (2011). We did not extend the data set to include observations beyond 2004 because the data on export promotion expenditures were not publicly available; these data were made available to Kinnucan and Cai (2011) from personal correspondence with representatives at the Foreign Agricultural Services, U.S. Department of Agriculture (see http://ajae.oxfordjournals.org/content/suppl/2010/10/29/aaq115.DC1/aaq115supp.pdf).

**Table 3.** Baseline Parameters for the Nonhorticultural Commodity Category (average values for 2000 to 2004)

| Parameter | Definition | Value | Reference |
|---|---|---|---|
| $A_G^n$ | Government expenditures for export promotion of nonhorticultural products (million $) | 36 | USDA Foreign Agricultural Service (2012a) |
| $\tilde{A}_x^n$ | Total expenditures for export promotion of nonhorticultural products (million $) | 108 | USDA-FAS |
| $A_I^n$ | Total industry spending on promotion of nonhorticultural products (million $) | 632 | Kinnucan and Cai (2011) |
| $A_d^n$ | Domestic promotional expenditures for nonhorticultural products (million $) | 560 | Kinnucan and Cai (2011) |
| $A^n$ | Total promotional expenditures for nonhorticultural exports (million $) | 668 | $A_I^n + A_d^n$ |
| $\theta_G^n$ | Government share of total nonhorticultural promotion expenditures | 0.05 | $A_G^n/A^n$ |
| $\theta_I^n$ | Industry share of total nonhorticultural promotion expenditures | 0.95 | $A_I^n/A^n$ |
| $\theta_d^n$ | Share of total nonhorticultural promotion expenditures spent in the domestic market | 0.84 | $A_d^n/A^n$ |
| $\theta_x^n$ | Share of total nonhorticultural promotion expenditures spent in the export market | 0.16 | $\tilde{A}_x^n/A^n$ |
| $P^nQ_s^n$ | Gross farm value of U.S. production for nonhorticultural products (million $) | 155,887 | USDA-ERS (2012) |
| $P_s^nQ_s^n$ | Net farm value of U.S. production for nonhorticultural products (million $) | 157,255 | Calculated |
| $P^nQ_x^n$ | Value of U.S. farm exports in nonhorticultural products (million $) | 37,603 | USDA Foreign Agricultural Service (2012a) |
| $P^nQ_d^n$ | Value of domestic consumption in nonhorticultural products (million $) | 120,284 | Calculated |

**Table 3.** Continued

| Parameter | Definition | Value | Reference |
|---|---|---|---|
| $\tau^n$ | Industry marketing fees for nonhorticultural products | 0.004 | Kinnucan and Cai (2011) |
| $k_d^n$ | Quantity share of nonhorticultural supply consumed in the domestic market | 0.76 | $P^n Q_d^n / P^n Q_s^n$ |
| $k_x^n$ | Quantity share of nonhorticultural supply consumed in the export market | 0.24 | $1 - k_d^n$ |
| $\varepsilon^n$ | Domestic supply elasticity for nonhorticultural products | 0.6 | Assumed |
| $\eta_d^{nn}$ | Domestic own-price demand elasticity for nonhorticultural products | –0.47 | Huang and Lin (2000) |
| $\eta_x^n$ | Export demand elasticity for nonhorticultural products | –2.36 | Estimated (see Table 4) |
| $\eta_d^{hn} = \eta_d^{nh}$ | Domestic cross-price demand elasticity between horticultural and nonhorticultural products | (0.10, 0.25) | Assumed |
| $\beta_A^n$ | Export promotion elasticity for nonhorticultural products | 0.109 | Estimated (see Table 4) |
| $\alpha_d^{nn}$ | Domestic own-promotion elasticity for nonhorticultural products | (0, 0.01, 0.05, 0.1) | Assumed |
| $\alpha_d^{nh}$ | Domestic cross-promotion elasticity for nonhorticultural products | (0, –0.001, –0.005, –0.01) | Calculated (see equation [4]) |
| $\varphi_x^n$ | Budget diversion elasticity for nonhorticultural products | 0.873 | Estimated |

in U.S. dollars; $X_t^{Wgdp}$ is the nominal per-capita gross domestic product for countries outside of the United States in year $t$ in U.S. dollars; $P_t^h$ is the unit value of U.S. horticultural exports in U.S. dollars per metric ton in year $t$, representing the market price; $P_t^n$ is the unit value of U.S. poultry exports in year $t$ (serving as a proxy for the market price of U.S. nonhorticultural products); $P_t^{C,h}$ is an index of real trade-weighted exchange rates for U.S. competitors' horticultural exports in year $t$ (serving as a proxy for the price of substitutes for U.S. horticultural products); $P_t^{C,n}$ is an index of real trade-weighted exchange rates for U.S. competitors' bulk and other processed product exports in year $t$ (serving as a proxy for the price of the substitute for U.S. nonhorticultural products); and $X_{t-1} / X_{t-1}^{Wgdp}$ represents the lagged dependent variable for the share of foreign income spent on U.S. agricultural exports. The term $DEFL_t$ is the gross national product deflator for countries outside of the United States in year $t$; $XR_t$ is the world U.S. agricultural trade-weighted real exchange rate; and $\mu_t$ is a random disturbance term.

The goodwill variable for the horticultural and nonhorticulture commodity categories, denoted as $GW_t^c$ in the model, where $c \in (h, n)$, is generated using data describing export promotion expenditures. Following Kinnucan and Cai (2011) and Nerlove and Arrow (1962), the goodwill variable for commodity category $c$ is defined as:

$$GW_t^c = AD_t^c + \delta AD_{t-1}^c + \delta^2 AD_{t-2}^c + \delta^3 AD_{t-3}^c,$$

where $AD_t^c = \tilde{A}_{x,t}^c \cdot SDR_t^c \Big/ DEFL_t$ is the real total U.S. promotional expenditures for commodity category $c$ exports in year $t$.[2]

The coefficients from models estimated following equations (3a) and (3b) are shown in Table 4. We report results for an unrestricted and a restricted specification for both commodity groupings. The unrestricted model is the full specification as outlined in equation (3a) for horticultural products and in equation (3b) for nonhorticultural products. In the restricted model we consider homothetic preferences and unitary demand elasticity by setting $\beta_Y^h = \beta_P^h = 0$ for horticultural products and $\beta_Y^n = \beta_P^n = 0$ for nonhorticultural products. In our regression results, the standard error of the regression, denoted as SE of Regression in Table 4 (where the greater the SE, the more unexplained variation is observed between the actual and predicted outcomes and the less accurate the model can explain the data) for the restricted models is nearly identical to those for the unrestricted models. It is slightly smaller for the restricted model in the estimation for horticultural products and slightly smaller for the unrestricted model in the estimation for nonhorticultural products. Therefore, we rely on the $\chi^2$ tests to decide which model to use and find evidence supporting the use of the restricted models in deriving the export promotion elasticity parameters. The coefficient on the goodwill variable, denoted as $\beta_A^c$, is the parameter of interest because it will be used directly in the simulation model to describe the response to export promotion efforts for the two commodity categories. Following the calculations outlined in Kinnucan and Cai (2011), the long-run promotional elasticity for horticultural products is 0.293 and it is 0.109 for nonhorticultural products.[3] Further details on the calculation of the long-run promotional elasticities are provided in the final footnote in Table 4.

[2] The retention parameter, δ, is set equal to 0.33 (following Kinnucan and Cai, 2011) for both commodity categories.

[3] These estimates indicate that foreign markets are more responsive to promotion efforts for U.S. horticultural exports compared with promotion efforts for all U.S. agricultural exports; the long-run elasticity estimated by Kinnucan and Cai (2011) was 0.189.

The literature provides estimated parameters describing domestic cross-advertising effects between products within the horticultural commodity category (e.g., Green, Carman, and McManus, 1991) or between products in the other product or commodity categories (e.g., Goddard and Amuah, 1989; Kinnucan et al., 2001; Piggott et al., 1996). However, others have not estimated domestic cross-advertising elasticities between the broad commodity groups studied here. Ignoring such cross-advertising effects in our simulation analysis may overstate the impact of advertising on domestic price and quantities (Kinnucan, 1996), and therefore we calculate the cross-advertising elasticities following Basmann (1956) in equations (4a) and (4b):

(4a) $$w^h \alpha_d^{hh} + w^n \alpha_d^{nh} = 0 \Rightarrow \alpha_d^{nh} = -\frac{w^h \alpha_d^{hh}}{w^n}$$

(4b) $$w^h \alpha_d^{hn} + w^n \alpha_d^{nn} = 0 \Rightarrow \alpha_d^{hn} = -\frac{w^n \alpha_d^{nn}}{w^h}$$

where $w^c = P^c Q_d^c \big/ . \left(P^h Q_d^h + P^n Q_d^n\right)$ is the budget share for commodity category $c$ and $c \in (h, n)$. We report the calculated cross-advertising elasticities for the horticultural commodity category in Table 2 and for the nonhorticultural commodity category in Table 3.

Baseline supply elasticities for both commodity categories are set equal to 0.6 in an effort to capture production response over a longer time horizon. Domestic demand elasticity for horticultural products is set at –0.72 because this is the average value of the estimates from Huang and Lin (2000) for the fruit and vegetable categories. For nonhorticultural products, we calculate the average elasticity reported by Huang and Lin (2000) for beef, pork, poultry, other meat, fish, dairy, and eggs (equal to –0.47) and use it to represent the elasticity for nonhorticultural commodities.[4] A

[4] A more recent set of elasticities for similar groups of commodities has been estimated in Okrent and Alston (2011), and they find evidence that the elasticity for horticultural commodities is closer to –0.9. Using a price elasticity of –0.9 for the horticultural group would strengthen the general set of results reported here, but it would not change the findings in a significant way and therefore we set the elasticity values for both horticultural products and nonhorticultural products using the estimates from Huang and Lin (2000).

**Table 4.** Econometric Results from Estimation of Export Demand[a]

| Variable/Statistic | Dependent Variable is U.S. Export Value Share for Horticultural Commodities: Coefficient Labels in Equation (3a) | Unrestricted Model[b] | Restricted Model[c] | Dependent Variable is U.S. Export Value Share for Nonhorticultural Commodities: Coefficient Labels in Equation (3b) | Unrestricted Model[b] | Restricted Model[c] |
|---|---|---|---|---|---|---|
| Constant | $\beta_0^h$ | –1.6701 (–0.85) | 0.3968 (0.66) | $\beta_0^n$ | 13.4165 (2.29)** | 0.7413 (1.34)* |
| Own price | $\beta_P^h$ | –0.0056 (–0.39) | – | $\beta_P^n$ | –0.2004 (–2.44)** | — |
| Substitute price | $\beta_{PS}^h$ | –0.03802 (–2.35)** | –0.2479 (–1.80)* | $\beta_{PS}^n$ | –0.2662 (–2.2498)** | –0.3395 (–4.31)*** |
| Exchange rate | $\beta_{XR}$ | –0.0954 (–0.36) | –0.2548 (–0.10)* | $\beta_{XR}$ | –0.5917 (–2.38)** | –0.2641 (–1.43) |
| Income | $\beta_Y$ | 0.2360 (1.09) | — | $\beta_Y$ | –1.3917 (–2.15)** | – |
| Goodwill | $\beta_A^h$ | 0.0599 (4.08)*** | 0.0739 (7.92)*** | $\beta_A^n$ | 0.0689 (3.02)*** | 0.0461 (4.75)*** |
| Lagged dependent variable | $\beta_{LAG}^h$ | 0.7050 (15.60)*** | 0.7481 (18.07)*** | $\beta_{LAG}^n$ | 0.4308 (4.59)*** | 0.5759 (8.48)*** |
| SE of regression | | 0.0571 | 0.0558 | | 0.0554 | 0.0569 |
| Computed $\chi^2$ for unrestricted versus restricted model | | | 1.33 | | | 5.96 |
| Significance level ($p$ value) | | | 0.5138 | | | 0.0507 |

[a] The t-ratios are shown in the parentheses where * indicates 10% significance level, ** indicates 5 % significance level, and *** indicates 1% significance level.

[b] The unrestricted model is the full specification as outlined in equation (3a) for horticultural products and in equation (3b) for nonhorticultural products.

[c] The hypothesis of homothetic preferences and unitary demand elasticity are assessed in the restricted model to estimate the sensitivity of relevant parameters; specifically the restrictions are $\beta_Y^h = \beta_P^h = 0$ for horticultural products and $\beta_Y^n = \beta_P^n = 0$ for nonhorticultural products. Results from the $\chi^2$ tests show that we do not reject the null hypothesis (at the 1% significance level) that the restricted model is nested within the unrestricted model. This indicates that the restricted and unrestricted models are statistically equivalent at the 1% significance level, and therefore we use the estimated coefficients from the simpler specification to calculate the long-run elasticities required in the simulation model. The estimated long-run export demand elasticity is equal to the negative value of one divided by one minus the estimated coefficient of the lagged dependent variable. Similarly, the long-run export promotional elasticity is equal to the (short-run) coefficient of the goodwill variable divided by one minus the estimated coefficient of the lagged dependent variable.

Note: SE, standard error.

range of values for the cross-price elasticity between the commodity categories is considered in our analysis; the baseline value was set at 0.10 and in the final simulation we set the value equal to 0.25 to better understand how sensitive our results are to this parameter. Kinnucan and Cai (2011) model consumer response to domestic promotion efforts using a range of domestic promotion elasticities between zero and 0.1. We adopt this range in our baseline analysis and then also consider an extended range for horticultural products as part of the sensitivity analysis.

Next we develop a link between the simulated changes in consumption and the corresponding changes in caloric consumption and nutrient intake. This is done to provide a quantitative examination of the dietary impacts for domestic consumers given changes in export and domestic promotion efforts. We use data describing food availability and food consumption to define the caloric consumption levels contributed from horticultural and nonhorticultural commodity categories.[5] We also use data describing the nutrient content found in various commodities to calculate the nutrient density for our horticultural and nonhorticultural commodity categories. These calculations are done for seven selected nutrients: cholesterol, fat, fiber, vitamin A, vitamin C, calcium, and iron.[6] Combining the proportional changes in consumption simulated in our economic model with the nutrient density information, we calculate the annual changes in caloric consumption and changes in intake of the selected nutrients. Results are provided across a range of simulation experiments and presented separately for the horticultural and nonhorticultural commodity categories.

## Results

Four simulations are conducted in our analysis that models the effects of a 10% decrease in government expenditures for export promotions coupled with a corresponding increase in expenditures for domestic promotion efforts under different scenarios. A simpler approach might consider an increase in domestic promotion alone; however, we decided to avoid complications associated with changes in taxpayer surplus and our approach assumes a budget-neutral reinvestment of the funds for domestic promotion. The first simulation examines the economic and nutritional effects from changes in government expenditures on promotion of both horticultural and nonhorticultural products. The second examines the effects when the changes in government expenditures for promotion are applied only to horticultural products. The third and fourth simulations repeat the exercise from the second simulation varying the cross-price (i.e., $\eta_d^{hn}$ and $\eta_d^{nh}$) and own-promotion $\left(\alpha_d^{hh}\right)$ elasticities for horticultural products, respectively. In the third simulation we examine the effects from greater consumer response to domestic promotion efforts for horticultural commodities than to nonhorticultural commodities (compared with equivalent promotional elasticities for the two commodity categories characterized in the second simulation). In this case we assume that the government develops a highly effective promotion campaign for fruits and vegetables and that consumers respond to the promotion in a more significant way than they did in the baseline analysis. The fourth simulation allows for greater substitution between horticultural and nonhorticultural commodities by consumers. For all simulations we show results across a range of domestic promotion elasticity parameters.

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[5] Because the caloric content for food consumed from different commodity categories is not available, we use the caloric content from data describing food supply (USDA Economic Research Service, 2012a) to generate shares of caloric intake in the two commodity categories. Based on these data and total daily caloric consumption of 2067 calories per day per adult, we set total calories from horticultural commodities to 214 and total calories from nonhorticultural commodities to 1853.

[6] We use loss-adjusted food availability data to describe the average nutrient intake in the consumption of horticultural and nonhorticultural products (USDA Economic Research Service, 2012a). Following this approach, the average intake of cholesterol, fat, fiber, vitamin A, vitamin C, calcium, and iron contributed from horticultural products is 0 mg, 4.5 g, 6.2 g, 154.7 μg, 52.3 mg, 66.1 mg, and 2.3 mg, respectively. For nonhorticultural products, the average intake is 364.9 mg, 86.6 g, 6.5 μg, 398.0 mg, 6.5 mg, 427.1 mg, and 9.7 mg for cholesterol, fat, fiber, vitamin A, vitamin C, calcium, and iron, respectively.

Our results are summarized in Tables 5 and 6. Here we show the effects on prices and consumption simulated from our model and the welfare measures derived following Wohlgenant (1993) for the horticulture and nonhorticulture commodity categories.[7] In addition, we use the simulated changes in quantities to calculate annual changes in caloric consumption and annual changes in the intake of selected nutrients; all of these changes are reported in the tables of results. We report the caloric changes separately for horticultural and nonhorticultural commodity categories because there is evidence that an increase in caloric consumption from foods derived from horticultural commodities, compared with nonhorticultural commodities, is associated with very small (or even negative) impacts on body weight. Ledikwe et al. (2006), Ludwig (2002), and Mozaffarian et al. (2011), among others, have studied relationships between specific foods or beverages and long-term weight gain and find evidence that the dietary quality influences dietary quantity. In particular, this body of research shows that long-term weight gain is inversely associated with the intake of fruits, vegetables, nuts, and yogurt; such patterns have been linked to the effects that these foods have on satiety and to how they displace consumption of other (more calorie-dense) foods and beverages. We also show the net caloric effects for each scenario in Tables 5 and 6.

Table 5 shows results from two simulations that model the effects of a 10% decrease in government support for export promotions with a redirection of these funds to domestic promotion efforts. The first simulation considers changes in promotional support for all commodities, and the second examines the effects when the changes apply only to promotional support for horticultural commodities. For both simulations we examine four levels of response to domestic promotion activities. The welfare results show that redirecting export promotion expenditures to domestic promotion efforts reduces producer surplus for both commodity categories as prices for both categories fall. This finding supports the widely held view that export promotion efforts increase producer welfare (e.g., see Henneberry, Mutondo, and Brorsen, 2009; Kaiser, Liu, and Consignado, 2003; Richards, Ispelen, and Kagan, 1997). Consumer surplus increases for all levels of response to advertising, and this is expected given the reverse cannibalization effects described previously.

In the first simulation we find an increase in the calories consumed of both horticultural and nonhorticultural products and an overall increase in caloric intake ranging between 645 and 1017 calories per person per year. Here we also see an increase in the intake of cholesterol, fat, fiber, and selected micronutrients across the different response levels. In the second simulation, we also see a net increase in caloric intake; however, in this simulation, the caloric intake from horticultural products increases and the caloric intake from nonhorticultural products decreases. The results in the second simulation show a decrease in the intake of cholesterol and fat and an increase in the intake of fiber and the selected micronutrients.

Using the daily recommendations for nutrient intake,[8] we can calculate the percentage changes in nutrient intake that would result from the various scenarios. For example, in the second simulation where we model a 10% decrease in export promotion expenditures for horticultural commodities only (diverting the funds to domestic promotion for horticultural commodities), a modest response to the promotion among consumers would decrease intake of cholesterol by 0.4%, decrease fat intake by 0.21%, and increase fiber intake by 0.63%. For the micronutrients, the intake of vitamin A, vitamin C, calcium, and iron would increase by 0.52%, 2.4%, 0.07%, and 0.42%, respectively.

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7 We develop formulas to describe changes in welfare measures for horticultural products and for nonhorticultural products; the calculations follow those presented in the supplementary appendix in Kinnucan and Cai (2011).

8 Daily Dietary Reference Intakes for the selected nutrients are available from the USDA Food and Nutrition Information Center (2012). Based on a recommended intake of 2000 calories per day, the recommended daily intake is 300 mg for cholesterol, 65 g for fat, 30 g for fiber, 760 μg for vitamin A, 73 mg for vitamin C, 1140 mg for calcium, and 11 g for iron.

**Table 5.** Economic and Nutritional Effects from a 10% Decrease in Government Expenditures for Agricultural Export Promotions with Reinvestment in Domestic Promotion

| Simulated Changes | | Decrease in Export Promotion for Horticultural and Nonhorticultural Products | | | | Decrease in Export Promotion for Horticultural Products Only | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Domestic Response to Advertising[a] | | | | | | | |
| | | No Response | Minor Response | Modest Response | Major Response | No Response | Minor Response | Modest Response | Major Response |
| Change in consumer price (%) | Horticultural | –0.93 | –0.95 | –1.05 | –1.18 | –2.21 | –2.14 | –1.85 | –1.47 |
| | Nonhorticultural | –0.36 | –0.35 | –0.31 | –0.26 | –0.11 | –0.12 | –0.15 | –0.19 |
| Change in quantity consumed (%) | Horticultural | 0.63 | 0.62 | 0.58 | 0.48 | 1.58 | 1.94 | 3.39 | 5.27 |
| | Nonhorticultural | 0.08 | 0.07 | 0.06 | 0.04 | –0.17 | –0.20 | –0.33 | –0.50 |
| Change in producer surplus (million $) | Horticultural | –228 | –234 | –257 | –289 | –540 | –523 | –452 | –361 |
| | Nonhorticultural | –571 | –555 | –492 | –409 | –174 | –186 | –236 | –302 |
| Change in consumer surplus (million $) | Horticultural | 117 | 115 | 106 | 88 | 279 | 344 | 607 | 953 |
| | Nonhorticultural | 436 | 421 | 362 | 281 | 132 | 179 | 369 | 614 |
| Change in social surplus[b] (million $) | Horticultural | –111 | –118 | –151 | –201 | –261 | –179 | 155 | 592 |
| | Nonhorticultural | –135 | –134 | –130 | –128 | –41 | –7 | 133 | 312 |
| | Net welfare effect | –246 | –252 | –281 | –329 | –302 | –186 | 288 | 904 |
| Change in annual caloric consumption per capita (calories) | Horticultural | 494 | 488 | 451 | 375 | 1233 | 1513 | 2651 | 4118 |
| | Nonhorticultural | 523 | 494 | 385 | 270 | –1144 | –1360 | –2241 | –3374 |
| | Net caloric effect | 1017 | 981 | 836 | 645 | 89 | 153 | 410 | 744 |
| Change in annual intake of selected macronutrients and micronutrients per capita | Cholesterol (mg) | 103.0 | 97.2 | 75.8 | 53.2 | –225.3 | –267.9 | –441.2 | –664.4 |
| | Fat (g) | 34.8 | 33.3 | 27.5 | 20.5 | –27.5 | –31.8 | –49.0 | –71.1 |
| | Fiber (g) | 16.1 | 15.9 | 14.4 | 11.8 | 31.7 | 39.1 | 68.9 | 107.5 |
| | Vitamin A (µg) | 469.2 | 458.6 | 408.7 | 328.9 | 645.8 | 801.5 | 1435.0 | 2252.3 |
| | Vitamin C (mg) | 122.5 | 120.9 | 111.6 | 92.5 | 297.4 | 365.0 | 640.0 | 994.6 |
| | Calcium (mg) | 273.0 | 264.4 | 228.0 | 178.0 | 117.3 | 153.7 | 302.3 | 494.4 |
| | Iron (mg) | 8.0 | 7.8 | 6.9 | 5.4 | 7.3 | 9.1 | 16.8 | 26.6 |

[a] Domestic promotion elasticities equal to 0.01 for the minor response, 0.05 for the modest response, and 0.1 for the major response. The cross-price elasticity is set equal to 0.10.
[b] Here we assume that there is no impact from the redirection of subsidies from export promotion to domestic promotion on taxpayer surplus.

**Table 6.** Additional Simulation Results for a 10% Decrease in Government Expenditures for Horticultural Export Promotions with Reinvestment in Domestic Horticultural Promotion

| Simulated Changes | | Increased Advertising Effectiveness of Government-sponsored Promotion for Horticultural Commodities[a] | | | Stronger Substitution Effect between Horticultural and Nonhorticultural Products[b] | | |
|---|---|---|---|---|---|---|---|
| | | Domestic Response to Advertising | | | | | |
| | | Minor Response | Modest Response | Major Response | Minor Response | Modest Response | Major Response |
| Change in consumer price (%) | Horticultural | –2.07 | –1.48 | –0.71 | –2.15 | –1.85 | –1.47 |
| | Nonhorticultural | –0.13 | –0.19 | –0.27 | –0.28 | –0.29 | –0.30 |
| Change in quantity consumed (%) | Horticultural | 2.29 | 5.22 | 9.06 | 1.90 | 3.38 | 5.29 |
| | Nonhorticultural | –0.23 | –0.49 | –0.84 | –0.45 | –0.55 | –0.67 |
| Change in producer surplus (million $) | Horticultural | –506 | –364 | –175 | –525 | –453 | –361 |
| | Nonhorticultural | –198 | –298 | –431 | –440 | –458 | –481 |
| Change in consumer surplus (million $) | Horticultural | 407 | 942 | 1669 | 358 | 673 | 1082 |
| | Nonhorticultural | 225 | 605 | 1105 | 655 | 1964 | 3637 |
| Change in social surplus[c] (million $) | Horticultural | –99 | 579 | 1493 | –167 | 220 | 722 |
| | Nonhorticultural | 27 | 307 | 674 | 215 | 1506 | 3156 |
| | Net welfare effect | –72 | 886 | 2167 | 47 | 1726 | 3878 |
| Change in annual caloric consumption per capita (calories) | Horticultural | 1789 | 4074 | 7080 | 1481 | 2643 | 4131 |
| | Nonhorticultural | –1575 | –3345 | –5670 | –3038 | –3705 | –4558 |
| | Net caloric effect | 214 | 730 | 1411 | –1557 | –1061 | –427 |
| Change in annual intake of selected macronutrients and micronutrients per capita | Cholesterol (mg) | –310.1 | –658.6 | –1116.5 | –598.2 | –729.6 | –897.6 |
| | Fat (g) | –36.0 | –70.6 | –116.1 | –110.8 | –117.6 | –126.1 |
| | Fiber (g) | 46.3 | 106.3 | 185.2 | 32.2 | 63.6 | 103.7 |
| | Vitamin A (μg) | 955.0 | 2226.8 | 3900.7 | 417.9 | 1115.2 | 2007.5 |
| | Vitamin C (mg) | 431.7 | 984.0 | 1710.5 | 351.2 | 633.0 | 993.7 |
| | Calcium (mg) | 189.6 | 487.5 | 880.2 | –242.8 | –37.4 | 225.5 |
| | Iron (mg) | 11.0 | 26.3 | 46.4 | 0.012 | 9.0 | 20.5 |

[a] In this simulation we double the domestic promotion elasticities for horticultural commodities (while keeping domestic promotion elasticities for nonhorticultural commodities at the same level as shown in Table 5); here they are set equal to 0.02 for a minor response, 0.10 for a modest response, and 0.20 for a major response. The cross-price elasticities remain at the baseline value (i.e., $\eta_d^{hn} = \eta_d^{nh} = 0.10$).

[b] In this simulation we hold the domestic promotion elasticities for horticultural commodities at the baseline value (i.e., $\alpha_d^{hh} \in [0.01, 0.05, 0.10]$) and increase the substitution between horticultural and nonhorticultural commodities to 0.25.

[c] Here we assume that there is no impact from the redirection of subsidies from export promotion to domestic promotion on taxpayer surplus.

In Table 6 we provide results for two additional simulations to test how sensitive the baseline results (in the second simulation) are to changes in key parameters. The third simulation examines an increased level of advertising effectiveness for horticultural commodities and the fourth simulation examines a greater degree of substitutability between the horticultural and nonhorticultural commodity categories (by consumers). Both of these simulations were designed as a way to better understand the upper limit in changes to caloric consumption and nutrient intake given a 10% decrease in export promotion for horticultural commodities only. In both of these cases, the results will be compared with those from the second simulation reported in Table 5.

In the case with greater advertising effectiveness of domestic promotion efforts for horticultural commodities (by doubling the domestic promotion elasticities for horticultural commodities used in the baseline analysis), we see larger increases in caloric consumption of horticultural commodities compared with the results in the second simulation. In addition, we also see greater decreases in caloric consumption of nonhorticultural commodities and an overall net consumption effect that shows a slightly larger increase in total calories consumed. In this simulation there are correspondingly larger effects in nutrient consumption with larger decreases in cholesterol and fat intake and larger increases in fiber and micronutrient intake. Given a modest response among consumers to the domestic promotion for horticultural products, the simulated results would lead to a reduction in fat intake by 0.30%, fiber intake would increase by 0.97%, and vitamin A intake would increase by 0.8%.

In the fourth simulation we consider how an increase in the substitutability between commodity categories by consumers, by increasing the cross-price elasticity, affects our baseline results. Here we find little change in the welfare effects for producers but do find that the consumer surplus change is greater when compared with the second simulation. In this fourth simulation, we see a net decrease in caloric intake, which is the result of a larger decrease in caloric consumption from nonhorticultural products. Because there is greater substitution between the commodity categories, and because there are relatively greater changes in the caloric intake of nonhorticultural products, we find larger decreases in cholesterol and fat intake as well as a decrease in the intake of calcium.

Overall, our simulation results indicate that a relatively small decrease in export promotion expenditures (and a budget-neutral reinvestment of those funds in domestic promotion efforts) for horticultural commodities would potentially have important economic effects and nontrivial nutritional implications. The results are particularly sensitive to the level of advertising effectiveness for domestic horticultural promotion efforts; we find that the nutritional implications are the greatest in the simulation that assumes a high level of effectiveness of government-sponsored promotion efforts for the horticultural commodity category.

## Summary and Policy Implications

The benefits of government-supported export promotion programs for U.S. producers of agricultural commodities have been well documented. There is also some evidence that these programs reduce domestic consumer welfare (Kinnucan and Cai, 2011). In this article we extend research in this arena by considering both the economic and nutritional consequences from changes in both export and domestic promotion efforts for agricultural commodities. A simulation model is developed to consider the effects for two commodity categories—horticultural and nonhorticultural commodities—and much of our analysis focuses on the implications of decreasing government expenditures on export promotion of horticultural commodities with the redirection of such spending toward domestic promotion efforts for the same commodities. More specifically, we are interested in the impact of a budget-neutral shift of government-supported advertising to promote the consumption of horticultural commodities in the domestic market (e.g., 5-A-Day programs).

A series of simulations were conducted to examine the effects of a decrease in government expenditures for export promotion coupled with a corresponding increase in domestic promotion for agricultural commodities. We consider the impacts from changes in export promotion applied to all agricultural commodities and from changes that apply only to horticultural commodities. We also explore how sensitive our baseline results are to the level of effectiveness for the domestic promotional campaign for horticultural products and to the level of substitution between the two commodity categories. Our results indicate that such redirection of promotion expenditures for horticultural products would decrease producer welfare and increase consumer welfare. The relatively large simulated increases in consumer surplus are described as a reverse cannibalization effect following Kinnucan and Cai (2011). When we focus on changes in promotional efforts for horticultural commodities, we see a net surplus gain when there is a modest and a major response to the advertising by domestic consumers. The net gain in social surplus increases as the advertising effectiveness for domestic horticultural promotion increases, and it increases notably as the level of substitution between the commodity categories increases.

Also, we provide results to highlight the corresponding changes in caloric consumption and nutrient intake from changes in promotional activities for horticultural products. Here we find that decreasing export promotion coupled with an increase in domestic promotion for horticultural commodities would lead to a relatively small decrease in caloric consumption from nonhorticultural commodities. However, we would also see an increase in caloric consumption from horticultural products and a corresponding increase in the intake of fiber and important micronutrients, which may have positive dietary effects. These positive effects on nutrient intake are largest when we consider an increased level of advertising effectiveness in government-supported promotional efforts for horticultural commodities in the domestic market.

This research was motivated by the observation that the U.S. government supports the promotion of horticultural commodities in foreign markets but does little to support promotion efforts in the domestic market. There is also evidence that publicly funded programs for domestic fruit and vegetable promotion have influenced consumption patterns in other countries. The purpose of our analysis is to understand both the economic and nutritional implications from redirecting export promotion funds toward domestic promotion efforts for fruits and vegetables. We extend previous work in this arena by examining how such changes in promotion expenditures would influence the markets and dietary patterns for two commodity categories, horticultural and nonhorticultural products. From a practical standpoint, our analysis sheds some new light on two policy debates in the United States: the costs and benefits of continuing the MAP and the effects of greater public investment in domestic advertising efforts for fruits and vegetables. The findings presented here provide policymakers, industry stakeholders, and social critics additional information that will allow for a further understanding of the economic effects and nutritional outcomes associated with government expenditures for promotion of fruits and vegetables at home and abroad.

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## References

Alston, J.M., C.C. Mullally, D.A. Sumner, M. Townsend, and S.A. Vosti. “Likely Effects on Obesity from Proposed Changes to the U.S. Food Stamp Program.” *Food Policy* 34,2(2009): 176–84.

Alston, J.M., G.W. Norton, and P.G. Pardey. *Science Under Scarcity: Principles and Practice for Agricultural Research Evaluation and Priority Setting*. Ithaca, NY: Cornell University Press, 1995.

Alston, J.M., D.A. Sumner, and S.A. Vosti. “Are Agricultural Policies Making Us Fat? Likely Links between Agricultural Policies and Human Nutrition and Obesity, and Their Policy Implications.” *Review of Agricultural Economics* 28,3(2006):313–22.

Basmann, R.L. “A Theory of Demand with Variable Consumer Preferences.” *Econometrica* 24,1(1956):47–58.

Beghin, J., and H. Jensen. “Farm Policies and Added Sugars in U.S. Diets.” *Food Policy* 33,6(2008):480–88.

Capacci, S., and M. Mazzocchi. “Five-a-Day, A Price to Pay: An Evaluation of the UK Program

Impact Accounting for Market Forces." *Journal of Health Economics* 30,1(2011):87–98.

Carman, H.F., and J.M. Alston. "California's mandated commodity programs." *The Economics of Commodity Promotion Programs: Lessons from California*. H.M. Kaiser, J.M. Alston, J.M. Crespi, and R.J. Sexton, eds. New York, NY: Peter Lang Publishing, Inc., 2005.

Cox, D.N., A.S. Anderson, J. Reynolds, S. McKellar, M.E.J. Lean, and D.J. Mela. "Take Five, a Nutrition Education Intervention to Increase Fruit and Vegetable Intakes: Impact on Consumer Choice and Nutrient Intakes." *The British Journal of Nutrition* 80,2(1998):123–31.

Ferrechio, S. "Doggy Glitter Gets a Share of Farm Bill Billions." Washington Examiner. Internet site: http://washingtonexaminer.com/article/1354981 (Accessed June 18, 2012).

Flegal, K.M., M.D. Carroll, C.L. Ogden, and L.R. Curtin. "Prevalence and Trends in Obesity among U.S. Adults, 1999–2008." *Journal of the American Medical Association* 303,3(2010):235–41.

French, S.A., and G. Stables. "Environmental Interventions to Promote Vegetable and Fruit Consumption among Youth in School Settings." *Preventive Medicine* 37,6(2003):593–610.

Gelber, L. "Farm Bill Should Buy the Farm." WasteWatcher: Citizens against government waste. Internet site: http://cagw.org/media/wastewatcher/farm-bill-should-buy-farm (Accessed June 2012).

Glanz, K., and A.L. Yaroch. "Strategies for Increasing Fruit and Vegetable Intake in Grocery Stores and Communities: Policy, Pricing and Environmental Change." *Preventive Medicine* 39,2(2004):75–80.

Goddard, E.W., and A.K. Amuah. "The Demand for Canadian Fats and Oils: A Case Study of Advertising Effectiveness." *American Journal of Agricultural Economics* 71,3(1989):741–49.

Green, R.D., H.F. Carman, and K. McManus. "Some Empirical Methods of Estimating Advertising Effects in Demand Systems: An Application to Dried Fruits." *Western Journal of Agricultural Economics* 16,1(1991):63–71.

Henneberry, S.R., J.E. Mutondo, and B.W. Brorsen. "Global Welfare Impacts of U.S. Meat Promotion Activities." *Agricultural and Resource Economics Review* 38,3(2009):418–30.

Huang, K.S., and B.H. Lin. Estimation of Food Demand and Nutrient Elasticities from Household Survey Data. Technical Bulletin 1887. U.S. Department of Agriculture, Economic Research Service, Food and Rural Economic Division, 2000.

Kaiser, H.M., D.J. Liu, and T. Consignado. "An Economic Analysis of California Raisin Export Promotion." *Agribusiness* 19,2(2003):189–201.

Kinnucan, H.W. "A Note on Measuring Returns to Generic Advertising in Interrelated Markets." *Journal of Agricultural Economics* 47,2(1996):261–67.

Kinnucan, H.W., and H. Cai. "A Benefit–Cost Analysis of U.S. Agricultural Trade Promotion." *American Journal of Agricultural Economics* 93,1(2011):194–208.

Kinnucan, H.W., Y. Miao, H. Xiao, and H.M. Kaiser. "Effects of Advertising on U.S. Non-Alcoholic Beverage Demand: Evidence from a Two-Stage Rotterdam Model." *Advances in Applied Microeconomics* 10(2001):1–29.

Lansing, R. "California Food & Ag Board Examines Impacts of Farm Bill Expiration: Wine and Grape Programs Affected." WineBusiness.com. Available at: www.winebusiness.com/news/?go=getArticle&dataid=107319 (Accessed November 9, 2012).

Le, C.T., H.M. Kaiser, and W. Tomek. "Export Promotion and Import Demand for U.S. Red Meat in Selected Pacific Rim Countries." *Agribusiness* 14,2(1998):95–105.

Ledikwe, J.H., H.M. Blanck, L.K. Khan, M.K. Serdula, J.D. Seymour, B.C. Tohill, and B.J. Rolls. "Dietary Energy Density Is Associated with Energy Intake and Weight Status in U.S. Adults." *The American Journal of Clinical Nutrition* 83,6(2006):1362–68.

Ludwig, D.S. "The Glycemic Index: Physiological Mechanisms Relating to Obesity, Diabetes, and Cardiovascular Disease." *Journal of the American Medical Association* 287,18(2002):2414–23.

Mangunkusumo, R.T., J. Brug, H.J. de Koning, J. van der Lei, and H. Raat. "School-Based Internet-Tailored Fruit and Vegetable Education Combined with Brief Counseling Increases Children's Awareness of Intake Levels." *Public Health Nutrition* 10,3(2007):273–79.

Mozaffarian, D., T. Hao, E.B. Rimm, W.C. Willett, and F.B. Hu. "Change in Diet and Lifestyle and Long-Term Weight Gain in Women and Men." *The New England Journal of Medicine* 364,25(2011):2392–404.

National Association of Wheat Growers. "Senator Foiled in Attempt to End Farm Bill Market Access Program (MAP)." AgFax.com.

Internet site: http://agfax.com/2012/07/19/senator-foiled-in-attempt-to-end-farm-bill-market-access-program-map/ (Accessed July 19, 2012).

Nerlove, M., and K.J. Arrow. "Optimal Advertising Policy under Dynamic Conditions." *Economica* 29,114(1962):129–42.

Okrent, A.M., and J.M. Alston. *Demand for Food in the United States: a Review of the Literature, Evaluation of Previous Estimates and Presentation of New Estimates of Demand.* Berkeley, CA: Giannini Foundation of Agricultural Economics Monograph 48. 2011.

———. "The Effects of Farm Commodity and Retail Food Policies on Obesity and Economic Welfare in the United States." *American Journal of Agricultural Economics* 94,3(2012):611–46.

Piggott, N.E., J.A. Chalfant, J.M. Alston, and G.R. Griffith. "Demand Response to Advertising in the Australian Meat Industry." *American Journal of Agricultural Economics* 78,2(1996):268–79.

Pollard, C.M., M.R. Miller, A.M. Daly, K.E. Crouchley, K.J. O'Donoghue, A.J. Lang, and C.W. Binns. "Increasing Fruit and Vegetable Consumption: Success of the Western Australia Go for 2&5® Campaign." *Public Health Nutrition* 11,3(2008):314–20.

Pomerleau, J., K. Lock, C. Knai, and M. McKee. "Intervention Designed to Increase Adult Fruit and Vegetable Intake Can Be Effective: A Systematic Review of the Literature." *The Journal of Nutrition* 135,10(2005):2486–95.

Richards, T.J., P.V. Ispelen, and A. Kagan. "A Two-Stage Analysis of the Effectiveness of Promotion Programs for U.S. Apples." *American Journal of Agricultural Economics* 79,3(1997):825–37.

Rickard, B.J., J. Liaukonyte, H.M. Kaiser, and T.J. Richards. "Consumer Response to Commodity-Specific and Broad-Based Promotion Programs for Fruits and Vegetables." *American Journal of Agricultural Economics* 93,5(2011):1312–27.

Rosson, C.P., M.D. Hamming, and J.W. Jones. "Foreign Market Promotion Programs: An Analysis of Promotional Response for Apples, Poultry and Tobacco." *Agribusiness* 2,1(1986):33–42.

Stables, G.J., A.F. Subar, B.H. Patterson, K. Dodd, J. Heimendinger, M.A.S. Van Duyn, and L. Nebeling. "Changes in Fruit and Vegetable Consumption and Awareness among U.S. Adults: Results of 1991 and 1997 5-a-Day for Better Health Program Surveys." *Journal of the American Dietetic Association* 102,6(2002):809–17.

USDA Economic Research Service. Food Availability (per capita) Data System. Internet site: www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system.aspx#26715 (Accessed October 15, 2012a).

———. U.S. and State Farm Income and Wealth Statistics. Internet site: www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx (Accessed October 15, 2012b).

USDA Food and Nutrition Information Center. Dietary Guidance: Tables, D.R.I. USDA Food and Nutrition Information Center (FNIC). Dietary Guidance: DRI Tables, Dietary Reference Intakes. Internet site: http://fnic.nal.usda.gov/dietary-guidance/dietary-reference-intakes/dri-tables (Accessed November 21, 2012).

USDA Foreign Agricultural Service. Global Agricultural Trade System (GATS). Internet site: www.fas.usda.gov/gats/ExpressQuery1.aspx (Accessed October 15, 2012a).

———. Total Available FY 2011 Funding for Market Access Program. Internet site: www.fas.usda.gov/info/webstories/map_042911.asp (Accessed October 15, 2012b).

———. Total Available FY 2011 Funding for Foreign Market Development Program. Internet site: www.fas.usda.gov/info/webstories/fmd_042911.asp (Accessed October 15, 2012c).

U.S. General Accountability Office. 1999. "Changes Made to Market Access Program, but Questions Remain on Economic Impact." NSIAD-99-38. *General Accountability Office.* Internet site: www.gao.gov/products/NSIAD-99-38 (Accessed August 21, 2012).

U.S. Grains Council (USGC). "Export Promotion Programs Under Fire as Farm Bill Debate Erupts on Senate Floor." *Feed and Grains.* Internet site: www.feedandgrain.com/news/10950117/export-promotion-programs-under-fire-as-farm-bill-debate-erupts-on-senate-floor (Accessed May 28, 2013).

Wohlgenant, M.K. "Distribution of Gains from Research and Promotion in Multi-Stage Production Systems: The Case of the U.S. Beef and Pork Industries." *American Journal of Agricultural Economics* 75,3(1993):642–51.

Zhang, Q., and Y. Wang. "Trends in the Association between Obesity and Socioeconomic Status in U.S. Adults: 1971 to 2000." *Obesity Research* 12,10(2004):1622–32.